

Table 1. Summary and references for background literature addressing correlations between food restriction and pubertal development.

Food Restriction % Control	Sex	Age	Duration	Reproductive Effects	Ref. (Author)
Litter enlargement M-↓30% bw F-↓32%	male and female	prepubertal d2-wean	20 days	delay PPS	Engelbregt et al., 2001.
34% of con diet	female	prepubertal	~ 9 weeks	delay VO	Messer and Anson, 2000.
Standardized litters (8) vs. natural litters, SM ↓ 9.5%, SF ↓ 9.0%	both, rat	PND3 cull	Prepubertal	No change in PPS or VO	Stoker et al., 2000a
decrease bw gain 15%, paired control	male rat	pubertal	31 days	delayed PPS 2 days	Stoker et al., 2000b
decrease bw gain 9.1%, paired control	female rat	pubertal	20 days	no delay in VO	Laws et al., 2000
Starvation for 4 days	male rat	prepubertal/ pubertal	~5 days	↓ Testosterone	Perheentupa et al., 1995.
90, 85, 79, and 74% of con bw	Male SD rats	Adult	15 day	74%↓ in bw ↓ liver, epi, & VP wt, ↓T, T3, T4, TSH	O'Connor et al., 2000
90, 80, & 70% of con BW	both in mice	adult	17 weeks	Ovary wt - 70% group; no effect on: VP, SV, testis, epi	Chapin et al., 1993.

Food Restriction % Control	Sex	Age	Duration	Reproductive Effects	Ref. (Author)
90, 80, & 70% of con BW	male and female mice	adult	21 weeks	SV- 80% & 70%, and VP & testis - 70%; ovary wt - 80% & 70% groups	Chapin et al., 1993.
Enough to maintain a certain bw 75g (at puberty, 50% of con BW)	female	prepubertal	~45 days	Hormones: ↓LH ↓FSH ↓Prl ↓GH	Bronson and Heideman, 1990.
Enough to maintain a certain bw 75g (at puberty, 50% of con BW)	female	prepubertal	17 weeks	VO and FO	Bronson, 1987.
30, 45, & 60% of 60-day bw	both in mice, male rats	prepubertal - adult	~ 9 weeks	ovary & uterus wt; testis & seminal vesicles	Hamilton and Bronson, 1986
30% of normal intake	male rat	prepubertal(PP), pubertal(P), & adult(A)	~18 weeks	prostate wt- P; seminal vesicles wt- PP, P, & A; testis wt- PP & P	Glass and Swerdloff, 1984
Litters of 12 or 8, ↓bw 25% of con bw at 20 days in 12/ litter	Wistar rats	Postnatal	Postwean on	No change in VO or PPS	Aguilar et al, 1984.
↓50% of con bw	Female SD rats	post weaning	chronic	VO at 227 days of age	Merry & Holehan, 1979 sim to 1985
Changed litter sizes, day 20 ↓13% and 32%	Female CR rats	Newborn, altered litter numbers	preweaning nutrition	No change in VO	Ronnekleiv, Ojeda & McCann, 1978

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Normal litters, food restriction to stop growth at wean	Female rats	Postweaning	Postwean to 65 days	Delayed VO 10 days, estrous cycle disrupted	Kennedy & Mitra, 1963.
50% of con bw at puberty from litter manipulations	Female rats	Postnatal litter size, large vs 3/litter	Postnatal on	Delayed VO 10 days	Widdowson and McCance, 1960.
50% ↓ from con bw, litters large and small (3)	Female rats	Postnatal litter size	Postnatal on	Delayed VO 10 days	Kennedy & Mitra, 1957.

REFERENCES

- Engelbregt, M.J.T., vanWeissenbruch, M.M., Pop-Snijders, C., Lips, P. and Delemarr-van de Waal, H.A. (2001) Body mass index, body composition, and leptin at onset of puberty in male and female rats after intrauterine growth retardation and after early postnatal food restriction. *Ped. Res.* 50(4):474-478.
- Messer, N.A., Anson, H. I. (2000) The nature of the metabolic signal that triggers onset of puberty in female rats. *Phys. & Behavior.* 68: 377-382.
- Stoker, T.E., Parks, L.G., Gray, L.E., Cooper, R.L. (2000) Endocrine Disrupting Chemicals: Prepubertal Exposures and Effects on Sexual Maturation in the Male Rat. A Focus on the EDSTAC Recommendations. *Crit. Rev. in Tox.* 30(2): 197-252.
- Stoker, T.E., Laws, S.C., Guidici, D.L., Cooper, R.L. (2000) The Effect of Atrazine on Puberty in Male Wistar Rats: An Evaluation in the Protocol for the Assessment of Pubertal Development and Thyroid Function. *Tox Sci.* 58: 50-59.
- Laws, S.C., Ferrell, J.M., Stoker, T.E., Schmid, J., Cooper, R.L. (2000) The Effects of Atrazine on Female Wistar Rats: An Evaluation of the Protocol for Assessing Pubertal Development and Thyroid Function. *Tox. Sci.* 58:366-376.
- Perheentupa, A., Bergendahl, M., Huhtaniemi, I., (1995) Modulation of gonadotropin secretion at the pituitary level by testosterone in gonadotropin-releasing hormone-treated male rats during food deprivation. *Biol. Reprod.* 52(4):808-13.
- O'Connor, J. C., David, L.G., Frame, S.R., Cook, J.C. (2000) Evaluation of a Tier I Screening Battery for Detecting Endocrine-Active Compounds (EACs) Using the Positive Controls Testosterone, Coumestrol, Progesterone, and RU486. *Tox. Sci.* 54: 338-354.
- Chapin, R.E., Gulati, D.K., Barnes, L.H., Teagur, J.L. (1993) The Effects of Feed Restriction on Reproductive Function in Sprague-Dawley Rats. *Fund. & Applied Tox.* 20:23-29.
- Chapin, R.E., Gulati, D.K., Fail, P.A., Russell, S.R., Heindel, J.J., George, J.D., Grizzle, T.B., Teague, J.L. (1993) The Effects of Feed Restriction on Reproductive Function in Swiss CD-1 Mice. *Fund. & Applied Tox.* 20: 15-22.
- Bronson, F.H., Heideman, P.D. (1990) Short-term hormonal responses to food intake in peripubertal female rats. *Am. J. Physiol.* 259(1):R25-31.
- Bronson, F.H. (1987) Puberty in female rats: relative effect of exercise and food restriction. *A. J. Physiol.* 252(1):R140-4.
- Hamilton, G.D., Bronson, F.H. (1986) Food restriction and reproductive development: male and female mice and male rats. *Am. J. Physiol.* 250(2):R370-6.
- Glass, A.R., Anderson, J., Herbert, D., Vigersky, R.A. (1984) Relationship between Pubertal Timing and Body Size in Underfed Male Rats. *Endocrinology* 115(1):19-24.
- Aguilar, E., Pinilla, L., Guisado, R., Gonzalez, D., Lopez, F. (1984) Relation Between Body Weight, Growth Rate, Chronological Age and Puberty in Male and Female Rats. *Revista Espanola de Fisiologia* 40:83-86.
- Merry, B.J., Holehan, A.M. (1979) Onset of puberty and duration of fertility in rats fed a restricted diet. *J. Reprod. Fert.* 57:253-259.
- Ronnekleiv, O.K., Ojeda, S.R., McCann, S.M. (1978) Undernutrition, Puberty and the Development of Estrogen Positive Feedback in the Female Rat. *Biol. Reprod.* 19: 414-424.
- Kennedy, G.C., Mitra, J. (1963) Body weight and food intake as initiating factors for puberty in the rat. *J. Physiol.* 166: 408-418.
- Widdowson, E.M., McCance, R.A., (1960) Some effects of accelerating growth I. General somatic development. *Proc. Roy. Soc.* 152: 188-206.
- Kennedy, G.C. (1957) The development with age of hypothalamic restraint upon the appetite of the rat. *J. Endocrin.* 16:9-17.